2006

Improving productivity in mixed-species plantations

Mila Bristow
Southern Cross University

J Doland Nichols
Southern Cross University

Jerome K. Vanclay
Southern Cross University

Publication details

Post-print of: Bristow, M, Nichols, JD & Vanclay, JK 2006, 'Improving productivity in mixed-species plantations', *Forest Ecology and Management*, vol. 233, no. 2-3, pp. 193-194.
Forest Ecology and Management home page available at www.elsevier.com/locate/foreco
Publisher's version of article available at http://dx.doi.org/10.1016/j.foreco.2006.05.010

M. Bristow, J.D. Nichols and J.K. Vanclay, 2006. Improving productivity in mixed-species plantations. *Forest Ecology and Management* 233:193-194.
doi:10.1016/j.foreco.2006.05.010

Improving Productivity in Mixed-Species Plantations

Mixed species plantations are often promoted as being environmentally preferable to monocultures, but are rarely considered operationally viable by commercial forest growers. Despite many publications documenting benefits demonstrated in research studies (e.g., Kelty 2006; Forrester et al. 2006b; Wood and Vanclay 1995), and despite continuing calls from a wide range of advocates for mixed-species plantations, polyculture remains the exception rather than the rule in industrial plantation forestry (Nichols et al 2006).

A workshop held in Ballina (NSW, Australia) during 5-7 August 2005 in association with the XXII IUFRO World Congress, sought to quantify the potential of mixtures to sustain and enhance the growth and productivity, soil fertility, tree and stand health, wood quality, and economics of polyculture plantations. Participants were specifically asked to address whether demonstrable productivity gains in mixed species plantations, compared with monoculture plantations, could make mixtures a commercially attractive option. We specifically sought to attract presentations addressing the operational challenges of making mixed-species plantations practical and successful, and attracted representatives from several industrial plantation agencies.

The workshop attracted 35 participants and 30 presentations, and stimulated an on-going discussion that has continued long after the formal workshop sessions were completed. This special issue includes 17 papers developed from workshop presentations, plus a further four papers that developed from discussions arising from the workshop.

The workshop stimulated presentations and papers, covering a wide range of topics including general overviews (Erskine et al. 2006; Forrester et al. 2006b; Jose et al. 2006; Kelty 2006), bi-cultures with nitrogen-fixing species (Bristow et al. 2006; Hunt

et al. 2006; Nichols and Carpenter 2006), economics (Nichols et al. 2006); experiment design (Vanclay 2006a); management guidelines (Reid 2006); nutrition (Specht and Turner 2006); photosynthesis and carbon dynamics (Medhurst et al. 2006; Forrester et al. 2006a; Unwin et al. 2006), predation (Bosu et al. 2006), spatially-explicit modelling (Bristow et al. 2006; Manson et al. 2006; Vanclay 2006b), trials with several rainforest species (Grant et al. 2006; Petit et al. 2006), and underplanting (McNamara et al. 2006; Simpson and Osborn 2006).

We draw the following important observations following the workshop and the compilation of the special issue:

- several innovative experiment designs (Vanclay 2006a) and analytical techniques (Bristow et al. 2006; Forrester et al. 2006b; Manson et al. 2006; Vanclay 2006b) have been demonstrated, and should provide useful models for others planning and examining mixed-species trials;
- despite the enthusiasm for polycultures, relatively few robust experiments have been established, and even fewer have been maintained long enough to allow rotation-length consequences to be evaluated (Forrester et al. 2006b);
- commercial polyculture plantations are even more scarce than experiments, and rarely offer data to support publication of financial analyses (Nichols et al. 2006);
- small landholders appear to be the main innovators in establishing and demonstrating polyculture plantations (Nichols et al. 2006).

To provide the evidence to encourage industrial uptake of polyculture plantations, we urgently need to establish

- a co-ordinated series of long-term trials, well replicated in time and space, using a standardised design with several treatments (species composition) and comparable species;
- operational-scale demonstration plantings that gather ecological, financial and social data as well as the conventional production data.

Acknowledgements

The workshop would not have been possible without the enthusiasm and energy of Therese Moffat and Denise Rall. We thank the following people who assisted by reviewing these and other manuscripts submitted for possible inclusion in this special issue: Alison Specht, Boris Zeide, Charles Canham, Daniel Mailly, David Cameron, David Forrester, David Lamb, David Larsen, Denis Alder, Emlyn Williams, Euan Mason, Florencia Montagnini, Frede Danborg, Ian Bevege, Jeff Goelz, Jenny Wong, Jim Ball, Jim Carle, John Evans, John Grant, John Parrotta, John Raison, John Turnbull, John Turner, Jonathan Massheder, JP Skovsgaard, Luis Ugalde, Martin Spetich, Matt Kelty, Michael Ryan, Nigel Turvey, Partap Khanna, Peter Erskine, Phil West, Sadanandan Nambiar, Shibu Jose, Steve Midgley and Yue Wang. Mila Bristow is supported by an Australian Research Council Linkage grant (LP0349299).

References

Bosu, P.P., Cobbinah, J.R., Nichols, J.D., Nkrumah, E.E., Wagner, M.R., 2006. Survival and Growth of Mixed Plantations of *Milicia excelsa* and *Terminalia superba* nine years after planting in Ghana. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.032.

Bristow, M., Vanclay, J.K., Brooks, L., Hunt, M., 2006. Growth and species interactions of *Eucalyptus pellita* in a mixed and monoculture plantation in the humid tropics of north Queensland. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.019.

Erskine, P.D., Lamb, D., Bristow, M., 2006. Tree species diversity and function: can multi-species plantations generate greater productivity?. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.013.

Forrester, D.I., Bauhus, J., Cowie, A.L., 2006a. Carbon allocation in a mixed-species plantation of *Eucalyptus globulus* and *Acacia mearnsii*. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.018.

Forrester, D.I., Bauhus, J., Cowie, A.L., Vanclay, J.K., 2006b. Mixed-species plantations of Eucalyptus with nitrogen fixing trees: a review. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.012.

Grant, J.C., Nichols, J.D., Pelletier, M.-C., Glencross, K., Bell, R., 2006. Five Year Results from a Mixed-Species Spacing Trial with Six Subtropical Rainforest Tree Species. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.027.

Hunt, M.A., Battaglia, M., Davidson, N.J., Unwin, G.L., 2006. Competition between plantation *Eucalyptus nitens* and *Acacia dealbata* weeds in north-eastern Tasmania. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.017.

Jose, S., Williams, R., Zamora, D., 2006. Belowground ecological interactions in mixed species plantations. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.014.

Kelty, M.J., 2006. The role of species mixtures in plantation forestry. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.011.

Manson, D.G., Hanan, J., Hunt, M., Bristow, M., Erskine, P.D., Lamb, D., Schmidt, S., 2006. Modelling predicts positive and negative interactions between three Australian tropical tree species in monoculture and binary mixture. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.028.

McNamara, S., Duong Viet Tinh, Erskine, P.D., Lamb, D., Yates, D., Brown, S., 2006. Rehabilitating degraded forest land in central Vietnam with mixed native species plantings. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.033.

Medhurst, J.L., Pinkard, E.A., Beadle, C.L., Worledge, D., 2006. Photosynthetic capacity increases in Acacia melanoxylon following form pruning in a two-species plantation. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.016.

Nichols, J.D., Bristow, M., Vanclay, J.K., 2006. Mixed species plantations: prospects and challenges. *Forest Ecology and Management*, in press.

Nichols, J.D., Carpenter, F.L., 2006. Interplanting *Inga edulis* with *Terminalia amazonia* yields nitrogen benefits to the timber tree. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.031.

Petit, B., Montagnini, F., 2006. Growth in Pure and Mixed Plantations of Tree Species Used in Reforesting Rural Areas of the Humid Region of Costa Rica, Central America. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.030.

Reid, R., 2006. Diameter-basal area ratio as a practical stand density measure for pruned plantations. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.037.

Simpson, J., Osborne, D., 2006. Performance of seven hardwood species underplanted to *Pinus elliottii* in south-east Queensland. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.021.

Specht, A., Turner, J., 2006. Foliar Nutrient Concentrations in Mixed-Species Plantations of Subtropical Cabinet Timber Species and their Potential as a Management Tool. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.029.

Unwin, G.L., Jennings, S.M., Hunt, M.A., 2006. Light environment and tree development of young *Acacia melanoxylon* in mixed-species regrowth forest, Tasmania, Australia. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.015.

Vanclay, J.K., 2006a. Experiment designs to evaluate inter- and intra-specific interactions in mixed plantings of forest trees. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.034.

Vanclay, J.K., 2006b. Spatially-explicit competition indices and the analysis of mixed-species plantings with the Simile modelling environment. *Forest Ecology and Management*, doi:10.1016/j.foreco.2006.05.020.

Wood, P.J. and J.K. Vanclay (eds), 1995. Papers from the IUFRO Tropical Silviculture Subject Group. *Commonwealth Forestry Review* **74**(4):281-343.

Mila Bristow, J. Doland Nichols and Jerome K Vanclay
Southern Cross University
PO Box 157, Lismore NSW 2480, Australia
JVanclay@scu.edu.au